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METHOD FOR PRODUCING AN ELONGATE HOLLOW COMPONENT COMPRISING A MOUNTING COMPONENT

The invention relates to a method for producing an elongate hollow component comprising a laterally protruding mounting component.

Such components comprising laterally protruding mounting components are disclosed by DE 196 18 626 C2. The elongate, hollow component referred to there serves as a motor vehicle support member, which over its extent is connected to various types of mounting components, which protrude laterally from the support member. The mounting components are here used as holders for attachments, which comprise, for example, a longitudinal column, a dashboard, a tunnel brace, holders for a heating system, for an airbag sensor and for a knee protector. In an internal high pressure forming tool the mounting components are positively gripped through expansion of the elongate, hollow component by means of a high internal fluid pressure, firmly joining them to the hollow component. The production cost of this process is relatively high, since the elongate, hollow component and the mounting components first have to be produced separately before embarking on the time-consuming task of arranging them in the internal high pressure forming tool as a prelude to the joining process. Furthermore, although the known joining technique is sufficient for the intended purpose of the hollow component and its mounting components in the form of holders inside the passenger compartment of a motor vehicle, the joining technique fails where the hollow component with its laterally protruding mounting component is arranged in areas of the motor vehicle which are exposed to high mechanical and thermal stresses. In this case the mounting components may readily be deformed or even break off.

The object of the invention is to demonstrate a method which will allow an elongate, hollow component comprising a laterally protruding mounting component to be produced at relatively low cost.

According to the invention the object is achieved by the features of claim 1.

The bending technique according to the invention allows the mounting component to be formed from the elongate, hollow component. This does not require any joining, so that the production of the component with the mounting component is easily achieved without the need for additional components. Since manufacturing of the hollow component and the mounting component do not involve separate production processes, each subject to production tolerances which therefore have a cumulative effect when they are assembled, the hollow component with the mounting component produced according to the invention will always have the same production tolerance, so that the precise component dimensions achieved substantially facilitate assembly of the hollow component comprising the mounting component with other components, or even make it possible to automate this process. The absence of joining seams and the forming of the mounting component from the inherently rigid, elongate hollow component mean that the hollow component comprising the mounting component is very rigid and resistant even to high mechanical and thermal stresses, so that the risk of fracture between the mounting component and the hollow, elongate component is extremely low.

In an especially preferred further development of the invention according to claim 2 the elongate component is produced using two hollow profiles arranged in series, the opposing ends of which are bent upwards or downwards into an equivalent position about the

horizontal axis and laterally inverted in relation to an imaginary transverse axis to the central longitudinal axis of the hollow profiles, and are then angled in the same direction, the two hollow profiles at their angled ends being joined, preferably welded, to one another to form the hollow component. This serves to substantially simplify the bending process for producing the hollow component with its protruding mounting component, since only one end of each hollow profile is bent and serves to form the mounting component. The fact that the angled ends of the hollow profiles directly adjoin one another means that it is possible to produce the mounting component with especially large mounting faces.

In another, likewise especially preferred further development of the inventive method according to claim 3 a partial section of the bent section is bent approximately 90° forwards about a further parallel axis separated by a vertical distance from the horizontal axis - parallel to the central longitudinal axis of the hollow component. The partial section is thus bent further in a lateral inversion of the preceding bending operations until an end section of the partial section aligns with the unbent remainder of the component. This variant of the method likewise gives the mounting component a large mounting face, whilst nevertheless avoiding any need for joining between hollow profiles as in the preceding further development of the invention according to claim 2.

In another preferred further development of the invention according to claim 4 the bent section is angled into a horizontal plane. This creates a secure support for attachments or fasteners and for the elongate, hollow component itself on adjoining components, which largely prevents any slipping of the components that are to be arranged against one another.

In another preferred development of the invention the bent section is flattened in its angled area. This creates a plane mounting face, which affords a better support for attachments on the mounting component and for the elongate, hollow component and the mounting component on other attachments or members. The flatness of the mounting face moreover allows the mounting component to be connected more easily, securely and firmly to other attachments.

In another preferred further development of the invention according to claim 6 the bent section is perforated in its angled area. The perforation turns the mounting component into a seat, on which the attachments can easily be fixed to the mounting component by means of the usual fasteners. The seat can furthermore function as a suspension eye, into which the correspondingly formed attachments can hook.

In another especially preferred further development of the invention according to claim 7 the flattening is bent downwards at a right angle at its edge lying parallel to the hollow component. This gives the mounting component a significantly increased rigidity. In addition the elongate, hollow component can be affixed to other components by the resulting hooked design shape of the mounting component.

In another preferred development of the invention according to claim 8 the hollow component, after bending, is expanded in an internal high pressure forming tool by means of a high internal fluid pressure. The expansion not only serves to even out and smooth unsightly folds and buckling produced during the bending process but, with the obvious exception of the flattened area, also restores the hollow component and the protruding mounting component to a virtually

tubular shape in the bent areas. The tubular shaping gives the mounting component and hence also the elongate, hollow component an extremely high flexural and torsional rigidity.

The invention is explained in more detail below with reference to two exemplary embodiments represented in the drawings, in which:

Fig. 1 shows a perspective view of details of a hollow component produced according to the invention and comprising a laterally protruding mounting component, comprising two hollow profiles arranged in series and joined to one another,

Fig. 2 shows a perspective view of a bent shape according to the invention for an elongate, hollow component, which at a point about a horizontal axis intersecting the central longitudinal axis of the hollow component at an angle of approximately 45° is bent upwards at an angle of approximately 90°,

Fig. 3 shows a perspective view of a bent shape according to the invention for an elongate, hollow component after a second bending phase following the bending according to Fig. 2,

Fig. 4 shows a perspective view of an elongate, hollow component bent according to the invention in a bent shape which results from a bending process of the bent hollow component in Fig. 3,

Fig. 5 shows a perspective view of the elongate, hollow component in Fig. 4 after a further bending process according to the invention forming the mounting component,

Fig. 6 shows the hollow component with laterally protruding mounting component in Fig. 5 after flattening and perforation of the mounting component produced according to the invention.

Fig. 1 shows an elongate, hollow component 1, which is made up of two hollow profiles 2 and 3 arranged in series. The opposing ends 4 and 5 of the profiles 2 and 3 are bent upwards at an angle of approximately 90° into an equivalent position about a horizontal axis 8 and laterally inverted in relation to an imaginary transverse axis 6 to the central longitudinal axis 7 of the hollow profiles 2 and 3, said horizontal axis intersecting the central longitudinal axis 7 at an angle of approximately 45°. The sections 9 of the hollow profiles 2 and 3 bent upwards and containing the respective ends 4 and 5 are bent in such a way that the bent sections 9 project laterally in relation to the longitudinal extent of the remainder of the component 1. The lateral projection 10 of the bent section 9 is angled at 90° into a horizontal plane at an offset height in relation to the remainder of the component 1. The angling of the two bent sections 9 points in the same direction. In the area of this angling the bent section 9 is in each case flattened, the flattening at its edge 11 lying parallel to the hollow component 1 being bent downwards at a right angle. In the area of its flattened angling the bent section 9 is perforated, forming a passage 12. The perforation, preferably produced by punching, can be undertaken, for example, when the two hollow profiles 2 and 3 have been joined together at their ends 4 and 5, preferably by welding. It is also feasible, however, to undertake this before joining the two hollow profiles 2 and 3, by forming a half-hole at each end 4 and 5 respectively. The bent, angled, flattened and perforated section 9 forms the laterally protruding mounting component, which may be

used, for example, as a spring strut seating in motor vehicle construction.

Figs. 2 to 6 in series each show a stage in the progressive manufacturing of a variant of an elongate, hollow component 13 produced according to the invention and comprising a laterally protruding mounting component 14. According to Fig. 2, at a point about a horizontal axis 16 intersecting the central longitudinal axis 15 of the hollow component 13 at an angle of approximately 45°, the one-piece elongate, hollow component 13, provided with a cylindrical cross section, is bent upwards at an angle of approximately 90°, the bent section projecting laterally in relation to the longitudinal extent of the remainder of the component 13. The lateral projection 18 of the bent section 17 is then angled at an offset height in relation to the remainder of the component 13 in order to form the mounting component 14, in such a way that a partial section 19 of the bent section 17 contained by the lateral projection 18 is bent forwards by approximately 90° about a further parallel axis 20 separated by a vertical distance from the horizontal axis 16, so that the partial section 19 runs parallel to the central longitudinal axis 15 of the hollow component 13 (Fig. 3). According to Fig. 4 the partial section 19 is now bent further in a lateral inversion of the preceding bending operation. For this purpose the partial section 19 is bent by approximately 90° downwards and back about a horizontal axis 21 likewise lying at the same height as the parallel axis 20 but at an angle of approximately 90° thereto, so that the free end 22 of the partial section 19 points approximately in a transverse direction to the longitudinal extent of the unbent part of the component 13.

Finally according to Fig. 5 the bent partial section 19 is bent forwards by at least 90° about an axis 23 which

is parallel to the horizontal axis 21 and which is separated by a downward vertical distance therefrom, corresponding to the position of the horizontal axis 16 relative to the parallel axis 20, so that an end section 24 of the partial section 19 aligns with the unbent remainder of the component 13. The area 25 of the partial section 19 lying parallel to the remainder of the component 13 is then flattened and the flattened area is thereupon punched to provide a hole 26, which may also be a passage.

In conclusion, the hollow component 13 thus formed is placed in an internal high pressure forming tool in which it is exposed to a high internal fluid pressure. This serves to expand not only the unbent area of the component 13 and the end section 24 of the partial section 19, but also to a certain extent the areas 27 of the component 13 projecting upwards at a right angle from the unbent area of the component 13 and from the partial section 19. As a result the vertical areas 27, crumpled relatively heavily during the bending process, recover very approximately the circular cross section of the unbent component 13 and thereby form very flexurally rigid spars. The said spar-like, vertical areas 27 and the flattened area 25 of the partial section 19 together form the mounting component 14. It is moreover also quite feasible in the exemplary embodiment according to Fig. 1 to expand the two hollow profiles 2 and 3 by means of a high internal fluid pressure, so that the bent sections 9, like the vertical areas 27 in the aforementioned exemplary embodiment, acquire a columnar shape, which affords particular flexural and torsional rigidity. The method according to the invention is not limited in its application to motor vehicle construction but may be used wherever elongate, hollow components comprising laterally protruding mounting components are required.